



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SERVICE REGULATIONS FOR GAS

By R. H. FERNALD, PH.D.,

Professor of Dynamical Engineering,
University of Pennsylvania.

When it is understood that the business of the gas utilities of this country furnishing manufactured gas amounts to over \$100,000,000 annually, to say nothing of the tremendous natural gas business, the need of definite standards for the conduct of a service that affects the majority of homes in every urban district becomes apparent. The larger cities have for many years exercised considerable supervision over the gas service of their respective communities but it is within a very few years that the regulation of gas utilities has been made a part of the responsibilities devolving upon the public service commissions of the states. Circular No. 32 of the bureau of standards shows the regulation of the gas utilities for 229 cities of more than 25,000 population to be as follows:

	Number of cities
State rules enforced.....	76
State commission has authority (unexercised).....	94
City ordinances enforced.....	78
No artificial gas supply.....	21
No rules enforced and no state commission in authority.....	12
Ordinances pending.....	4
Municipal operation.....	3
<hr/>	
Total, less duplicates.....	229

Twenty-one states do not attempt regulation of such companies and of the twenty-seven states that have the power, but few have commissions that have prescribed definite rules or have taken steps to regulate the character and quality of the gas supplied. Massachusetts is reported as the first state to enforce regulations of gas service, a state inspector having been appointed in 1861. A state commission was appointed in 1902 which has controlled such matters since that date. In 1907 the Railroad Commission of Wisconsin was given power to supervise and regulate every public utility in the state. Several state commissions have been organized within the

past five years and the work now being carried on under the direction of these commissions is attracting conspicuous attention as the purpose, efficiency and fair-mindedness of these organizations become better known.

In preparing rules for the regulation of any public utility the underlying principle should always be one of fair treatment for both the public served by the utility and the utility itself. The stringent regulations that might be consistently met by certain large gas companies in the larger cities might prove absolutely prohibitive when imposed upon the smaller companies of a state with limited financial backing. The rules adopted by a state commission must, therefore, be thoughtfully and fairly drawn. On the one hand, they must impose high standards of gas quality, pressure and uniformity of service and on the other they must impose no undue hardships upon the smaller companies. Any rules or regulations that place excessive demands upon a utility result in increased expense and any increase in the cost of manufacture or distribution must ultimately be borne by the public. It is, however, but fair that the price charged shall warrant adequate and satisfactory service and shall allow a fair return on the invested capital.

A thinking public is willing to pay a fair price for efficient gas service but is not willing to meet an increased price with no apparent increase in efficiency of service or quality of gas. In formulating rules, to govern the production, sale or distribution of gas it is important that they be so drawn as to be fair in every detail to both the public and the utility company. It is also important that, although the requirements must be rigid, they should not be so rigid as to prohibit the possibility of their proper enforcement.

From utilities furnishing gas service the public has a right to expect

1. Gas of good and reasonably uniform quality.
2. Satisfactory and reasonably uniform gas pressure.
3. Correct appliances for measuring the gas used by each customer.
4. Freedom from interruptions to service and avoidance of accidents.
5. Reasonable prices for the service rendered.
6. Proper distribution and readiness to serve all communities within the natural territory supplied by the utility.

For a great many years the quality of gas was largely determined by means of the so-called candle power requirement and many

ordinances and regulations today still cling to the candle power test. When open flame gas burners were in general use the candle power standard was undoubtedly the most effective and altogether satisfactory one. Today, however, when probably not over 10 per cent of the total gas used is consumed in open burners it is questionable whether the candle power standard is of any real service in determining gas quality. For use in connection with gas ranges for cooking, incandescent mantles for lighting, furnaces, ovens and pits for heating, and gas engines for power development, a quality requirement based on the heating value of the gas seems to be more consistent today than a candle power requirement and the double standard recommended by some seems quite unnecessary. Experts in the field of gas manufacture seem to be almost unanimous in the feeling that proper regulation of heating value can be more readily obtained than of candle power. They are, therefore, distinctly of the opinion that in general the one standard, heating value, is the desirable one. It is undoubtedly true that in certain sections of the older cities open flame burners are more or less in use and it is possible that in a few of these cities these burners may utilize as much as 25 per cent of the gas supplied to these communities but these burners are rapidly being displaced by the mantle type and when natural gas is taken into consideration it is probable that the total gas utilized in open flame burners will fall well below the 10 per cent limit indicated above. The need, therefore, of the candle power standard seems to be obsolete. Assuming that, for state regulation, the single standard of heating value is to be adopted, it becomes necessary to determine the definite heating values which shall serve as limits in the regulations imposed. At least two heating value standards must be recognized, one for manufactured gas and one for natural gas.

Several kinds of manufactured gas have to be considered. Usually they are coal gas, carbureted water gas, coke oven gas, mixed gas and oil gas. Coal gas is made by the destructive distillation of coal in retorts which are externally heated. Approximately 5 cubic feet of gas are secured per pound of coal and the heat value of such gas usually ranges from 550 to 630 b.t.u. per cubic foot. Carbureted water gas is the result of a combination of two gas-making processes. Water gas is generated by turning a jet of steam upon an incandescent fuel bed. This water gas is usually enriched by the addition of gas generated from oil, the resultant gas being known as carbureted

water gas. The larger portion of the illuminating gas in this country is of this type. Carbureted water gas usually has a heating value ranging from 500 to 650 b.t.u. per cubic foot. Coke oven gas is practically a regular coal gas but the process of manufacture is somewhat different from that of the so-called coal gas. The primary object of the coke plant is the manufacture of coke and the gas generated is practically a by-product. The heating value of coke oven gas is usually somewhat lower than that of ordinary coal gas. Mixed gas—many plants today are manufacturing a so-called mixed gas which is nothing more nor less than a mechanical mixture of carbureted water gas and coal or coke oven gas. Oil gas—in the oil districts of the country large quantities of gas are made directly from crude oil.

In determining the proper standard for the heating value of gas in any community it is essential that the types of gas manufactured in that territory be carefully considered and that the efficiency of the processes of manufacture or the individual standards of the companies furnishing this commodity be taken into account when first establishing a basis for regulation. This is essential because it is important that sufficient leeway be granted to meet the commercial conditions involved in the manufacture of the different types of gas of reasonable quality supplied in the different sections of a state. It should further be recognized that to impose too rigorous conditions during the early application of new laws may mean either excessive expense to the smaller companies, resulting in an abnormal increase in the cost of gas to the public or the impossibility on the part of the utility to carry out the requirements imposed. An examination of the heating value standards of various states and cities shows the average to be about 600 b.t.u. per cubic foot; but in the majority of these cases the gas is limited to the three varieties, namely, coal gas, carbureted water gas or mixed gas. It is usually customary in all such regulations to permit a maximum variation of 50 heat units below the average monthly requirement, that is, the usual stipulation is that the utility furnishing manufactured gas service must supply gas of not less than 600 b.t.u. total heating value per cubic foot as referred to standard condition of temperature and pressure and that the minimum heating value shall never fall below 550 b.t.u.

It is undoubtedly true that many companies are today manufacturing gas of a considerably lower heat value than they imagine.

Owing to the fact that they have not been working under strict regulations they have never actually made any heat value determinations but assume that the gas which they manufacture is necessarily equal in heat value to that of certain other plants from which they have obtained information. A recent report of a joint committee on calorimetry of the public service commission and gas corporations of a state that has been living under gas regulation for several years indicates that even without considering coke oven gas the 600 heat unit standard seems high and this committee has seen fit to recommend an average standard of 570 b.t.u. If coke oven gas becomes an important factor it seems consistent to make the standard even lower than that recommended by this committee.

As a summary of the various recommendations and of the regulations now in force, the following requirements seem consistent for the best results today:

For states already working under gas regulations and in which the manufactured gas supply consists entirely of coal gas, carbureted water gas and mixed gas, a standard of 570 b.t.u. per cubic foot for the monthly average seems to be very satisfactory, although for states in which gas regulation is just being introduced or in which coke oven gas plays an important part, this heat value standard may in some instances be wisely reduced slightly below these figures, with a minimum in each case, as previously outlined, of 50 heat units below the monthly average.

The heat value of natural gas ranges from about 700 to over 1100 b.t.u. per cubic foot. It seems to be consistent to require a quality of natural gas that shall insure a heat value of not less than 800 heat units as a minimum. These heat value determinations of the gas are made on the basis of recognized standard conditions of temperature and pressure.

Gas manufacturers who have been accustomed to no special standards can undoubtedly improve the uniformity of the quality of the gas supplied by their plants and it is quite consistent for a state commission to increase its requirements from time to time.

The phrase "quality of gas" not only relates to its heating value but also to freedom from impurities. Manufacturers of gas are expected satisfactorily to control, among other impurities, the proportions of hydrogen sulphide, total sulphur and ammonia. Gas engineers seem to differ radically as to the seriousness of a trace of hy-

drogen sulphide in gas. Some claim that a trace does absolutely no harm save that the odor produced when the gas is burned is objectionable. Others claim that this odor serves a useful purpose in warning of leaks or open valves. The removal of hydrogen sulphide is a comparatively simple process and the gas company that has any interest in the attitude of its customers will see that its gas is free from this somewhat offensive impurity. It seems, therefore, hardly necessary to include any requirements regarding hydrogen sulphide, but gas regulations should specify the total amount of sulphur that will be permitted. Inasmuch as it is quite possible in good practice with the grades of coal used today to reduce the amount of sulphur to 20 grains or less per 100 cubic feet of gas produced, it has become customary to make the maximum limit as prescribed in the regulations, 30 grains of total sulphur per 100 cubic feet. This serves as a regulator and at the same time cannot be regarded as a hardship.

The regulation of the pressure at which gas is supplied to the customer's appliances seems to be imperative if service is to be of a thoroughly satisfactory nature. This is emphasized distinctly in the following passage from the 1909 report of the Wisconsin Railroad Commission:

It has been shown that in general the gas furnished in cities of this state has been of good quality and the value has been uniform. In spite of this fact, complaint is frequently heard of "poor gas." The summary of gas complaints and our own experience have shown "poor gas," as the consumer uses the term, to be synonymous with "poor pressure" and may be due to one or more of a number of causes. It may be that the pressure furnished to the mains is inadequate, that the service or house piping is inadequate or otherwise faulty, or that the pressure is unsuited to the adjustment of the appliances in which gas is used. In most cases, however, it goes back to the matter of pressure. For this reason, the control of the gas pressure is the most important single factor in securing satisfactory service. The use of gas has been greatly extended in the last few years and all of the appliances which have come into use require a higher pressure than the old open flame burner. It is stated in the discussion of pressure in a former bulletin that the pressure under $1\frac{1}{2}$ inches is unsatisfactory. Most of the companies in the state maintain a standard pressure of about $2\frac{1}{2}$ inches, and it has been noticed in general, where the pressure drops below 2 inches, complaints are heard.

Owing to this tendency to increase gas pressures, the majority of gas appliances are today regulated for pressures of from 2 to

6 inches of water pressure when operating on manufactured gas and for a somewhat higher range of pressures when operating on natural gas. Experience seems to show that the most satisfactory results are secured with incandescent mantles, gas ranges and other household appliances when the pressure is greater than 2 inches. When gas appliances have been adjusted for certain definite pressures it is exceedingly difficult to get satisfactory results if the pressure is allowed to fluctuate through wide ranges or at frequent intervals. It becomes incumbent upon the gas companies, therefore, to hold pressures within certain ranges and to control the daily variation within reasonable limits. Such pressure requirements as the following seem to protect the public on the one hand and to be entirely fair to the utility on the other.

Each utility furnishing manufactured gas shall maintain at the consumer's meter outlet a gas pressure of not less than $1\frac{1}{2}$ inches nor more than 8 inches of water pressure and within said limits the daily variation of pressure at the outlet of any one meter on the system shall never be greater than 100 per cent of the minimum pressure. Each utility furnishing natural gas shall maintain at the consumer's meter outlet a gas pressure of not less than $1\frac{1}{2}$ inches nor more than 14 inches of water pressure, except when greater pressure is specifically provided in the contract between the utility and the consumer, provided there shall be no unfair and unreasonable discrimination or preference, and within the said limits the daily variation of pressure at the outlet of any one meter on the system shall never exceed four inches of water pressure above or below the normal pressure maintained at such point of delivery, unless it can be shown to the commission that such greater variation is due to extraordinary demand in extreme weather. Provided, that variations in pressure caused by operation of the customer's apparatus in violation of contract or the rules of the utility or from causes entirely beyond the control of the utility shall not be considered a violation of this rule.

In order that the consumer may be assured of the correctness of bills submitted for gas service rendered, it becomes imperative that some definite standard of reliability be adopted for meters used in measuring the gas. In general it has been found that the accuracy of properly constructed gas meters may easily be maintained within two per cent when passing gas at a rate of flow common in commercial use. It is, therefore, consistent to stipulate that no gas meter shall

be placed in service which shows in comparison with a standard gas prover an error greater than 2 per cent when passing gas at its standard test rate of flow. It also becomes important in the interest of good service that the accuracy of such meters shall be definitely checked periodically. Each utility should, therefore, be required to check the accuracy of all meters within stated periods and to readjust them if found to be incorrect. Experience has shown that such meters should be checked for accuracy at least every five years.

From time to time consumers feel that their gas meters are inaccurate and that their bills are excessive. Although meters may register in favor of the gas company, yet as a rule when they are in error, their registration is favorable to the consumer. The impression regarding the inaccuracy of a meter is sometimes due to natural but overlooked causes, such as extreme weather conditions, social functions, or other temporary but excessive gas demands.

It is customary, therefore, to make provision for the checking of any meter at the request of any consumer under certain specified conditions. Among other conditions imposed it seems consistent to require the consumer to pay a reasonable fee for such special test if the meter so tested shall be found to be accurate within the limits specified by the regulations, but if the meter is not so found, then the cost of the test should not fall upon the consumer.

Satisfactory service from a gas company implies continuity of service at all times and a reasonable protection from injury to persons or property resulting from defective equipment or carelessness. With this in view, service regulations should require of the utility an inspection of its equipment and facilities with the necessary tests for water and leaks therein. The utility should also be required to supply records and reports of the conditions found upon inspection, of interruptions to service and of any and all accidents related in any way to the company's equipment or facilities, necessary to give the commission all desired information.

Modern business methods accompanied by improved systems of manufacture and distribution have tended toward a reduction in the price of gas, but this reduction has been largely offset by the increased cost of materials, fuel and labor. Higher standards of service are constantly demanded by the public, but any attempt on the part of a utility to increase prices is met with stubborn resistance. Disinterested, impartial, and fair regulation is needed in such cases.

A public service commission is the natural body to adjust such matters and the public should recognize the propriety of an increase in the price of gas just as much as a decrease when the character of the service rendered warrants it or requires it in order to guarantee a reasonable financial return.

It is important that utilities supplying gas in a community be ready to serve the entire community within the natural territory supplied. Discrimination cannot be permitted and districts reasonably populated have a right to expect reasonable consideration. The general responsibility of gas utilities to the public is to furnish and maintain such service, including facilities, as shall in all respects be just, reasonably adequate and practically sufficient for the accommodation of its patrons, employees, and the public.

In conclusion, it should be said that it is today the policy of many gas companies to maintain standards of service and of gas quality that are superior to any demands that would be made by any regulations that would, in general, be just to both utility and consumer. There are, however, companies in every community that have never known any standard and a definite basis for their future procedure is required. A sane application of reasonable regulations will result in high standards of gas quality and service, uniformly fair prices and reasonable financial returns; a more cordial relation between the public and gas companies, and finally, a better understanding of the underlying principles that make for good government and a square deal for all.